

**REMARKS**

Claims 18-38 are pending in this application. Claims 18, 23, and 25 - 27 are independent claims. Claims 18-21, 23-28, 30, and 37 stand rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 5,095,760 to Lew (hereinafter “Lew”) in view of U.S. Patent No. 4,876,897 to DeCarlo et al. (hereinafter “DeCarlo”). Applicants respectfully traverse the rejections.

Applicants note with appreciation that the Examiner deems claims 22, 29, 31-36, and 38 to recite allowable subject matter.

**The Claimed Invention and Prior Art**

The claimed invention is generally directed to a method of monitoring a two-phase fluid flow utilizing a vortex flowmeter. Application at Abstract. Instead of suppressing amplitude and periodicity fluctuations, as is conventionally done, the claimed invention analyzes those fluctuations and thus yields valuable information about the fluid flow regime. Application at [0029]. The claimed invention utilizes a single vortex flowmeter to measure the flow, even when the total mass flow rate is not known. Application at [0059]-[0105].

Lew is generally directed to measuring flow rate in a single-phase flow. Response to 5/11/2007 Office Action, pages 8-10. The Lew reference, being directed to the measurement of a single phase flow, does not disclose a two- or a three- phase fluid flow. Office Action at 3. DeCarlo is directed to measuring two-phase flows consisting of wet steam, under certain conditions. DeCarlo at Abstract. The DeCarlo reference describes calculating the flow rate based on either a previously known mass flow rate, or a second series of sensors. DeCarlo at Abstract; DeCarlo at col. 4, line 44 – col. 5, line 21.

**§103 Rejections**

The Examiner rejects claims 18-21, 23-28, 30, and 37 under 35 U.S.C. §103(a). The Examiner asserts as the basis for this rejection that “it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Lew’s method to include a

two or a three phase fluid flow, as taught by DeCarlo.” Office Action at 3. In order to establish a *prima facie* case for obviousness, there must be some suggestion or motivation to modify a reference. MPEP §2143. The Examiner claims that the motivation to modify Lew is to gain knowledge of the mass flow rates of both flow phases so that the velocities and densities of each phase can be determined. Office Action at 3. Applicants respectfully submit that there is no suggestion or motivation in this case, for the reasons described below.

*The Proposed Modification Renders Lew Unsatisfactory for its Intended Purpose*

The Examiner suggests that Lew can be modified to include a two or a three phase flow, as taught by DeCarlo. Office Action at 3. The prior art must include some suggestion or motivation to modify the Lew reference according to the method taught by DeCarlo. MPEP §2143. However, there is no suggestion or motivation to modify the reference if a proposed modification would render the prior art invention unsatisfactory for its intended purpose. MPEP §2143.01.V. A modification renders the prior art invention unsatisfactory for its intended purpose if the proposed modification would make the modified invention inoperable. MPEP §2143.01.V (citing *in re Gordon*, 733 F.2d 900 (Fed. Cir. 1984)).

In this case, modifying Lew to measure a multiple phase flow would render Lew inoperable. The flowmeter in Lew has a structure, function and operation to measure only a single phase flow. Lew is not concerned with measuring one phase of a multiple phase flow. If Lew were modified to measure a multiple-phase flow, as taught by DeCarlo, Lew’s measurements would be rendered inaccurate. This inaccuracy results from the equation which Lew relies on to calculate the density of the flow. In Lew, the density of the flow is calculated from the following equation:

$$\text{Density} = A/(KQ^2),$$

where K is a constant,  $Q^2$  is the square of the fluid velocity, and A is the amplitude of the alternating fluid dynamic lift forces as measured by the planar vortex force sensing member. Lew at col. 6, lines 49-53. As Applicants demonstrated in their Response to the Office Action dated 5/11/2007, the measurement of the amplitude (A above) becomes unreliable when a single flowmeter measures a multiple phase flow. That Response provides a demonstration of how, in a scheme where the amplitude of the alternating fluid dynamic lift forces is used to calculate the density of a multiple phase flow, the calculated density is incorrect. Response to 5/11/2007

Office Action, pages 9-10. DeCarlo does not suggest any way to modify the equation for use with multiple-phase flows.

Moreover, Lew's invention relies on vortex and noise sensors that eliminate noise from the vortex shedding frequency. Lew at col. 5, line 66 – col. 6, line 6. Lew describes how to cancel noise in a single-phase flow. However, Lew does not describe how to cancel noise in a multiple phase flow, where the noise detected would travel through two or more media having different structures, and the relative proportions of those media would be constantly changing. Thus, noise detection would become difficult, if not impossible. Lew does not disclose a way in which noise might be cancelled in a multiple-phase flow.

It follows that Lew's invention can only operate to measure single-phase flows. Because the modification would render Lew inoperable, and thus unsatisfactory for its intended purpose, there are no predictable results, and, hence, there is no suggestion or motivation to modify Lew.

*The Proposed Modification Changes the Principle of Operation of Lew*

Moreover, if the proposed modification of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. MPEP §2143.01.VI. Lew's principle of operation involves obtaining certain data from the flowmeter: the amplitude of the alternating fluid dynamic lift forces as measured by the planar vortex force sensing member and the vortex shedding frequency. Lew at col. 6, lines 44-54. Lew then utilizes that data to calculate three variables: the volume flow rate; the mass flow rate; and the density of the flow. Lew at col. 6, lines 44 – 64.

The process can be described as follows: (1) measure the vortex frequency; (2) calculate the velocity of the fluid flow from the vortex frequency; (3) calculate the volume flow rate from the velocity; (4) measure the amplitude; (5) calculate the density from the amplitude and velocity; (6) calculate the mass flow rate from the density and volume flow rate. Lew at col. 6, line 44 – col. 7, line 16. This process relies on measuring the amplitude: without the amplitude, the density cannot be calculated, and without the density, the mass flow rate cannot be calculated.

In any combination of Lew and DeCarlo, the amplitude measurement could not be used. The substitute scheme used by DeCarlo is to: (1) gather the values for the velocity and density of the liquid from a first series of sensors; (2) combine these to get the mass flow rate of the liquid;

(3) gather the values for the velocity and density of the gas from a second series of sensors; (4) combine these to get the mass flow rate of the gas; (5) divide the mass flow rate of the gas phase by the total mass flow rate to calculate steam quality. DeCarlo at col. 7, lines 33-60. This is a wholly different principle of operation than Lew utilizes.

Lew's principle of operation relies on obtaining the amplitude value from the flowmeter and then calculating density from it, while DeCarlo measures density directly, using a sensor. As described above, the amplitude cannot be relied upon when calculating density in a multiple phase flow. Any modification of Lew which would enable the invention to work in multiple phase flows would thus require a change in Lew's principle of operation. Such a change in principle cannot serve as the basis of an obviousness rejection.

Thus, Applicants respectfully submit that the prior art does not render the claimed invention obvious. Applicants respectfully request that the Examiner withdraw the rejection of claims 18-21, 23-28, 30, and 37 under 35 U.S.C. §103(a).

**CONCLUSION**

In light of the above, Applicant respectfully submits that all of the pending claims are in condition for allowance. Should the Examiner feel that a teleconference would expedite the prosecution of this application, the Examiner is urged to contact the Applicants' attorney at (617) 227-7400.

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